
HAFNIUM RESONANCE PARAMETER ANALYSIS USING NEUTRON CAPTURE AND TRANSMISSION EXPERIMENTS

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The focus of this work is to determine resonance parameters for stable hafnium isotopes in the 0.005 - 200 eV region, with special emphasis on the overlapping Hf-176 and Hf-178 resonances near 8 eV. The large neutron cross section of hafnium, combined with its corrosion resistance and excellent mechanical properties, make it an ideal material for controlling nuclear reactions.

Experiments measuring neutron capture and transmission were performed at the Rensselaer Polytechnic Institute (RPI) LINAC using the time of flight method. Li-6 glass scintillation detectors were used for transmission experiments at flight path lengths of 15 and 25 m. Capture experiments were done using a sixteen section NaI multiplicity detector at a flight path length of 25 m. These experiments utilized various thicknesses of metallic and isotope-enriched liquid samples. The liquid samples were designed to provide information on the Hf-176 and Hf-178 contributions to the 8 eV doublet without saturation.

Data analysis was done using the R-matrix Bayesian code SAMMY version M6 beta. SAMMY is able to account for experimental resolution effects for each of the experimental setups at the RPI LINAC, and also can correct for multiple scattering effects in yield data. The combined capture and transmission data analysis yielded resonance parameters for all hafnium isotopes from 0.005 - 200 eV. Resonance integrals were calculated along with errors for each hafnium isotope using the NJOY and INTER codes. The isotopic resonance integrals calculated were significantly different than previous values; however the calculated elemental hafnium resonance integral changed very little.